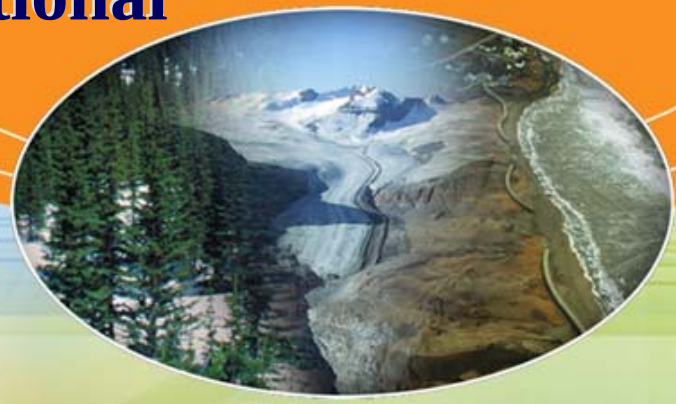
Change and Fragmentation Monitoring:
Initial Results for Prince Albert National Park, Saskatchewan, Canada



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Contributions from:
Ian Olthof & Richard Fernandes

March 2, 2005

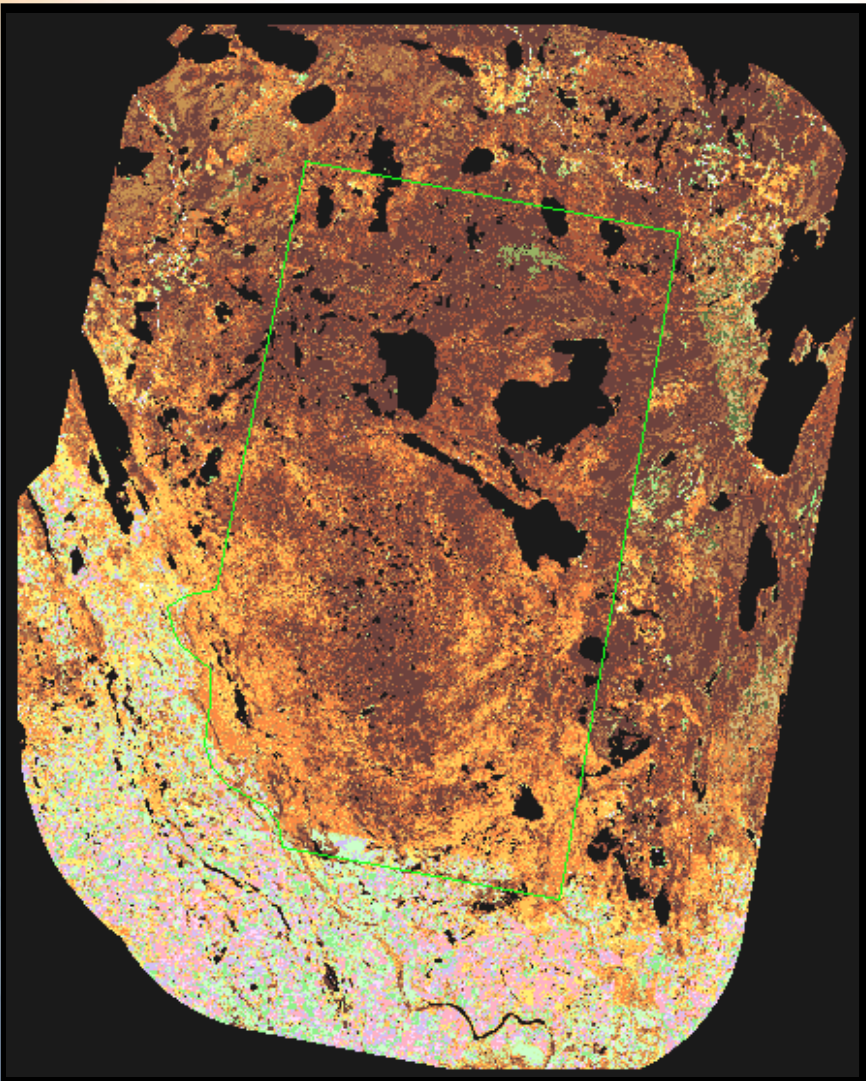
Natural Resources Canada
Ressources naturelles Canada

Canada

Change Detection Methods Developed at the Canada Centre for Remote Sensing

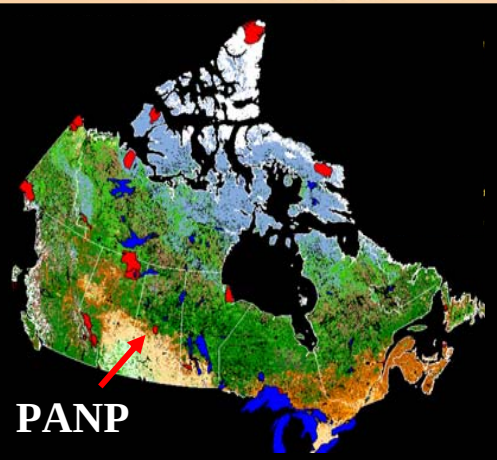
1. **Spectral change detection and change type identification:**
   a. **Change metric fusion (ChangeSat, R. Fraser);**
   b. **Cross correlation (C. Butson);**
   c. **Change vector analysis (R. Latifovic).**
2. **Signature extension and post classification comparison (I. Olthof).**
3. **Combined 1 & 2, landcover reclassification in change areas using constrained signature extension (R. Latifovic & D. Pouliot).**

Prince Albert National Park (PANP)



Common tree species:

- **Trembling aspen;**
- **Balsam poplar;**
- **White spruce;**
- **Black spruce;**
- **Balsam fir.**



Signature Extension Methodology

Implementation:

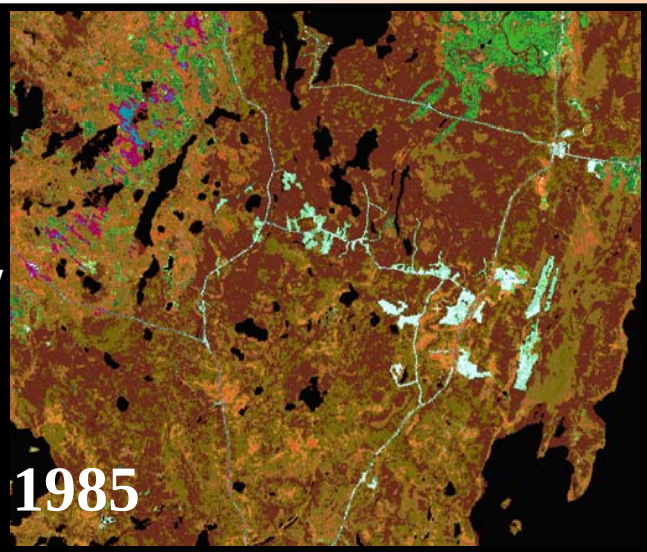
1. Theil-Sen\VGT normalized imagery generated for 1985, 1990, 1995, and 2000;
2. 1995 landcover generated using the Enhanced Classification Method;
3. Class spectral statistics extracted from baseline 1995 landcover map;
4. 1985,1990, and 2000 classifications produced using 1995 class statistics with the minimum distance classifier;
5. Change identified by comparing maps between years.

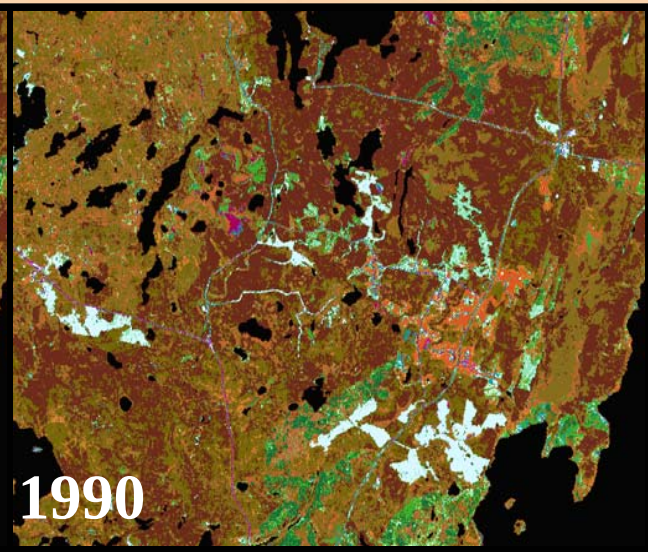
At a thematic resolution of 2 classes (forest/non-forest) average map agreement between years was ~ 90 %. Assuming actual change between years was ~ 5 %, suggests ~ 5 % change error.

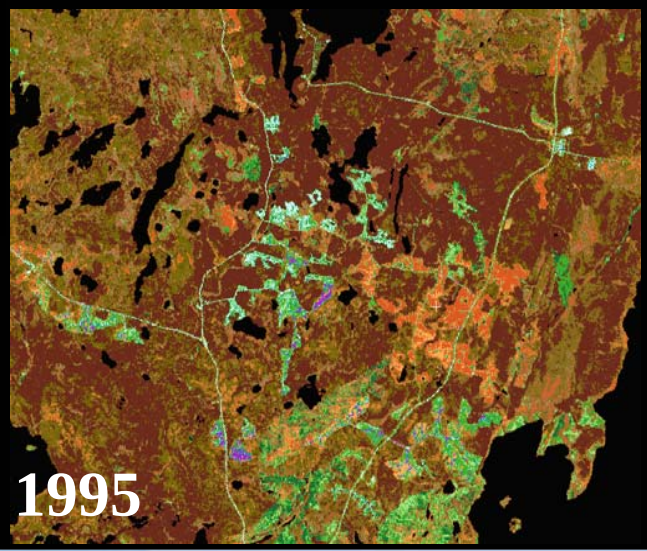
Signature Extension Results:

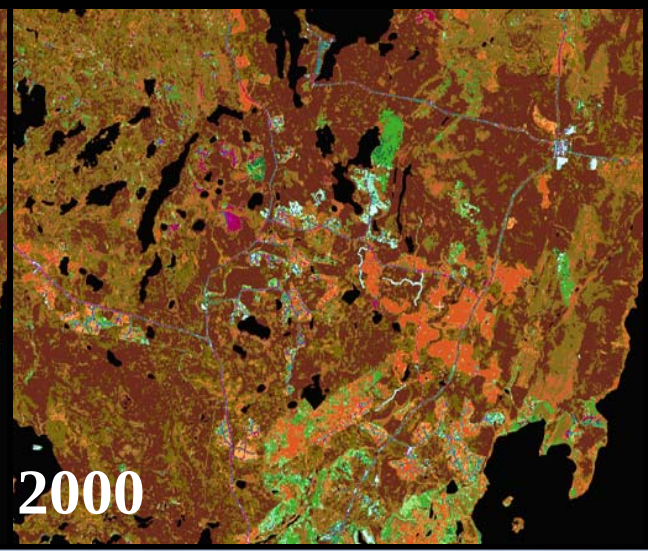
Harvesting and Regeneration

- Evergreen closed tree canopy
- Deciduous closed tree canopy
- Mixed closed tree canopy
- Mixed deciduous closed tree canopy
- Evergreen open tree canopy w/ moss-shrub
- Evergreen open tree canopy w/ shrub-moss
- Low regen. To young broadleaf cover
- Mixed evergreen deciduous open tree canopy
- Mixed deciduous open tree canopy
- Low regen. To young mixed cover
- Deciduous shrubland
- Grassland, prairie region
- Wetlands
- Temperate grassland sparse conferous
- High biomass crops and grasses
- Medium biomass crops and grasses
- Low biomass crops and grasses
- Low vegetation cover, rock outcrops
- Recent burns
- Mostly bare disturbed areas
- Low vegetation cover after disturbance









Signature Extension Results:

Fire

- Evergreen closed tree canopy
- Deciduous closed tree canopy
- Mixed closed tree canopy
- Mixed deciduous closed tree canopy
- Evergreen open tree canopy w/ moss-shrub
- Evergreen open tree canopy w/ shrub-moss
- Low regen. To young broadleaf cover
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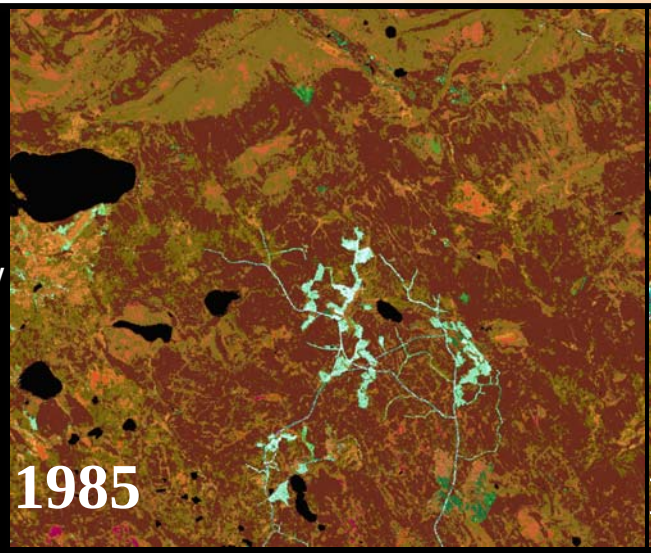
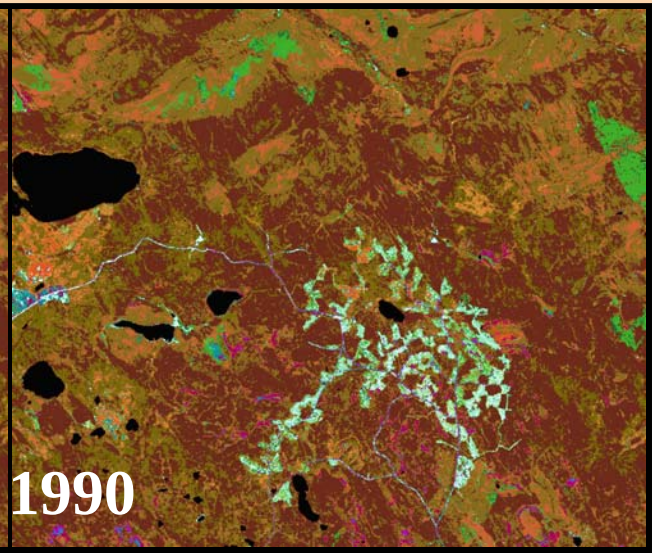
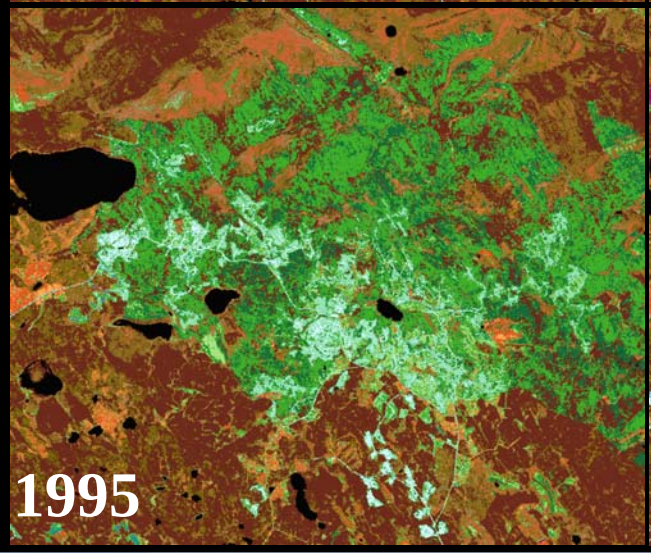
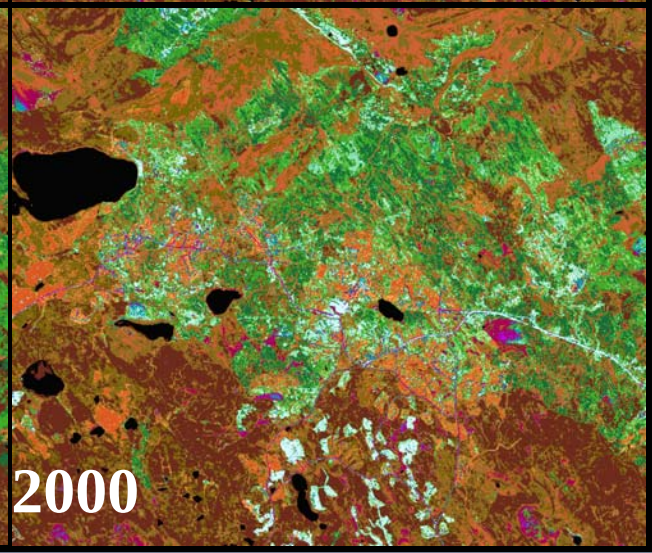


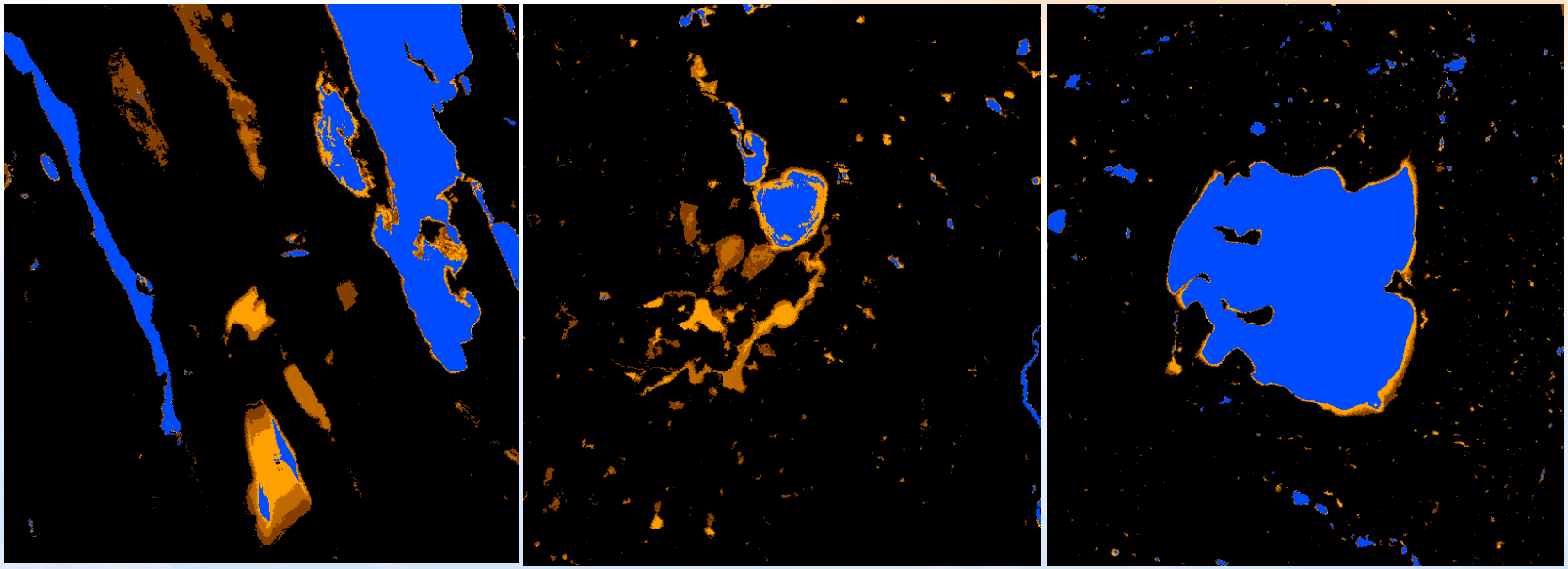






Signature Extension Results:

Water Table Changes

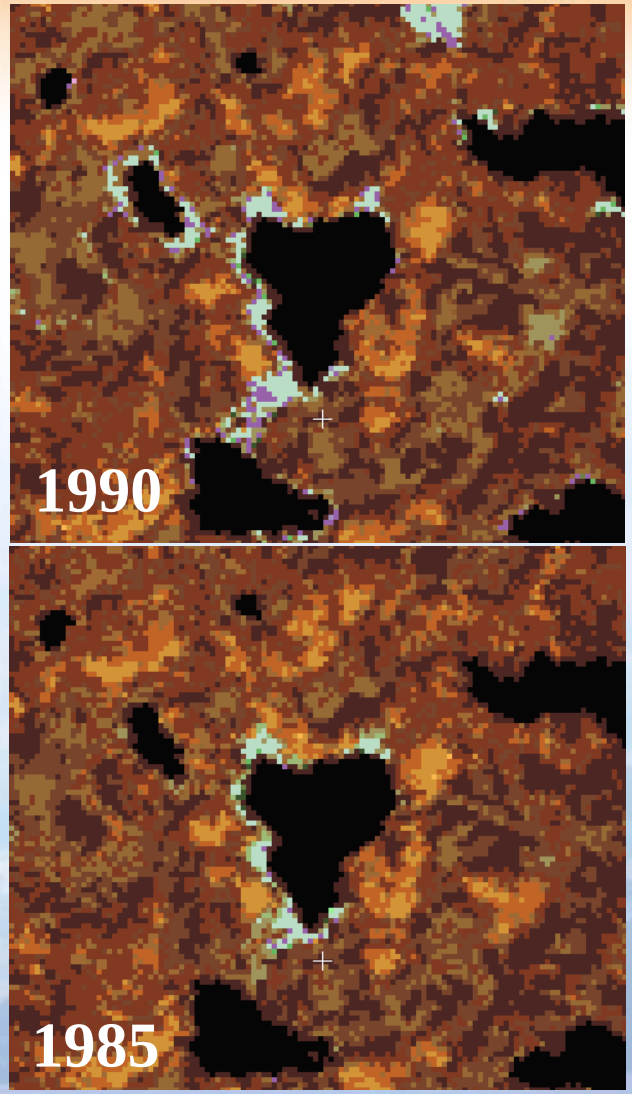


- Water 2000
- Dried between 1995 - 2000
- Dried between 1990 - 1995
- Dried between 1985 - 1990

Lakes are shrinking over time, perhaps caused by drought in the region over the past 20 years. Lakes shrink more in the prairies than in the shield just north, likely due to the fact that prairie lakes are shallower.

Signature Extension Results:

Water Table Changes

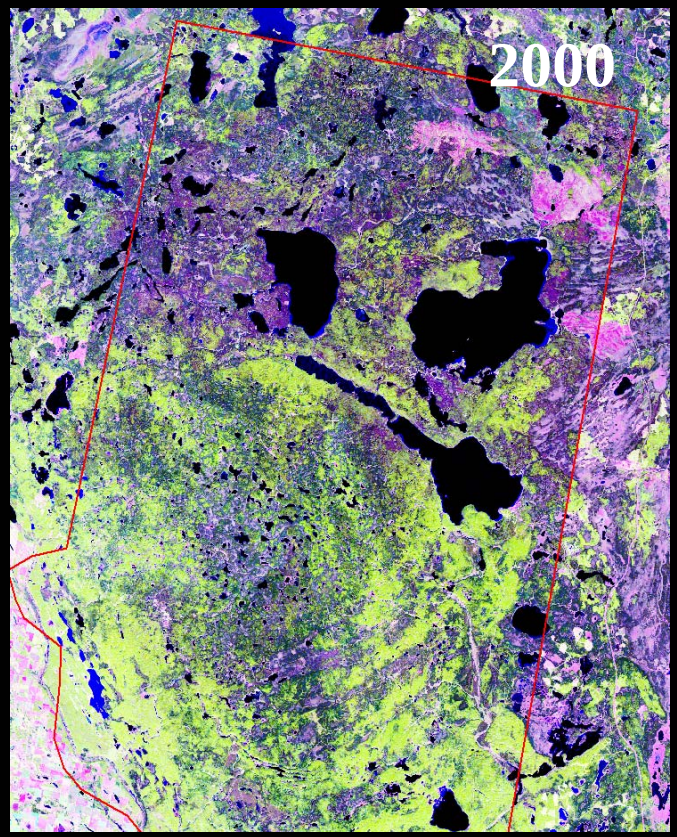


Fluctuations in water table drastically alter spectral properties of wetland areas and ∴ the identified landcover classes.

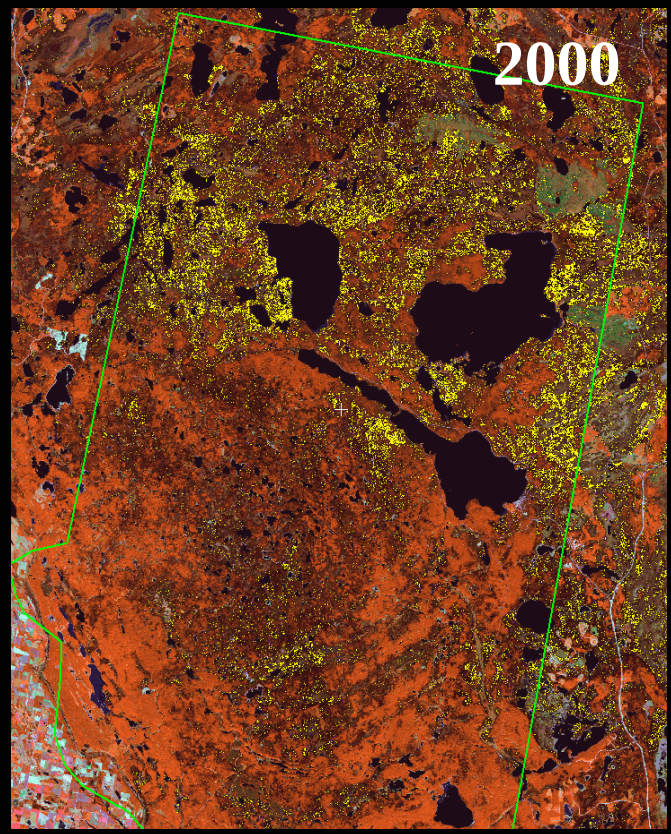
Signature Extension Results:

Defoliation

Defoliation survey for park in 2000 from Saskatchewan Environment and Resource Management.



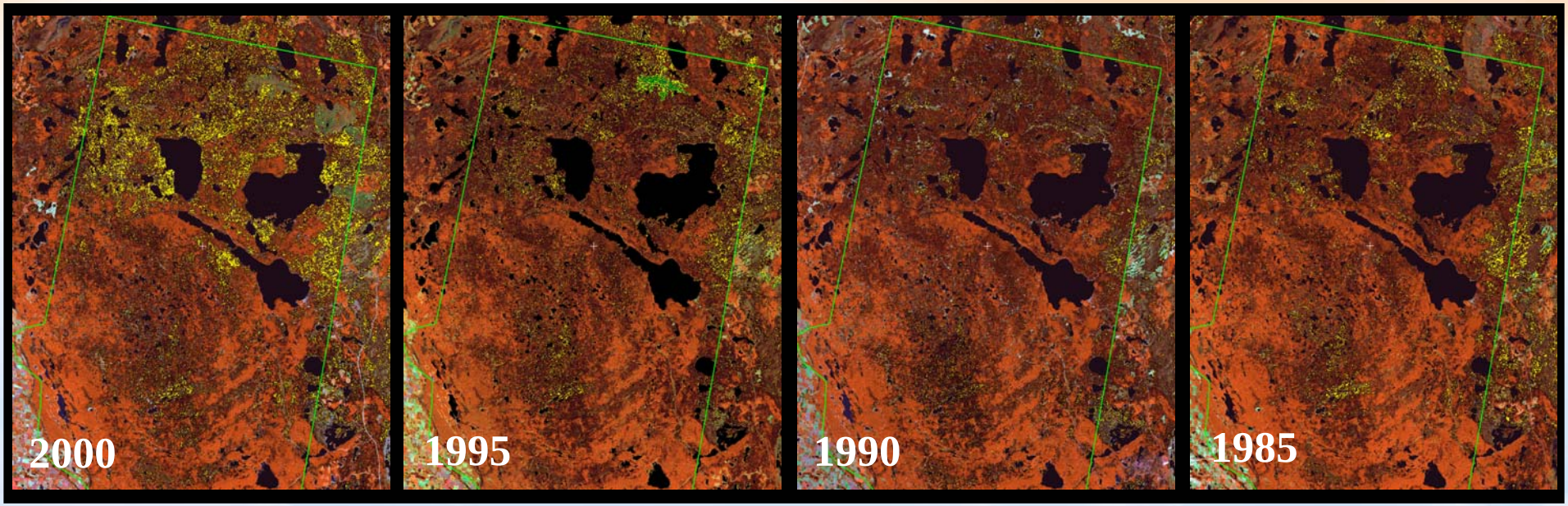
Defoliation appears dark purple with SWIR, NIR, RED displayed as R, G, B.



Clusters defined as defoliation are shown in yellow.

Signature Extension Results:

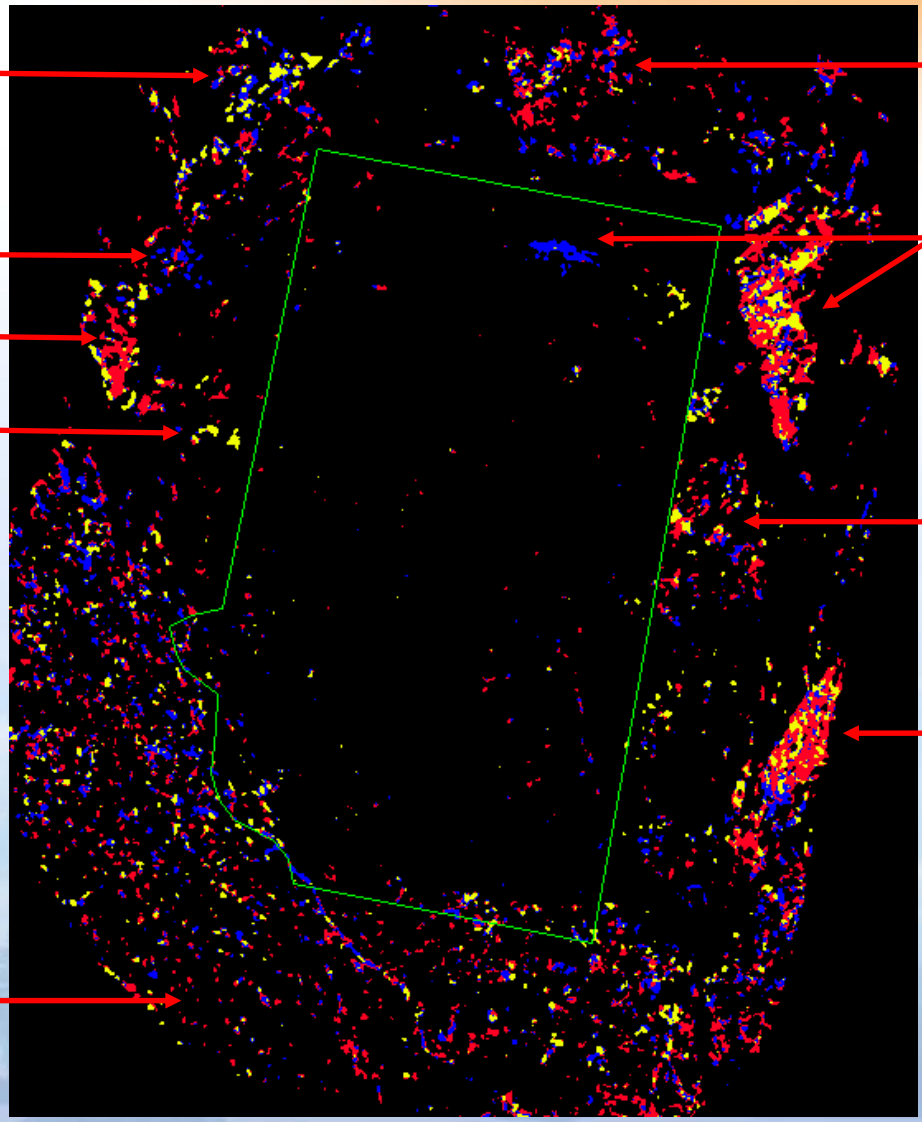
Defoliation



Defoliation signatures were extend backward in time from 2000 to identify the potential past distribution.

Signature Extension Results:

Summary of Changes



Change

- 1985-1990
- 1990-1995
- 1995-2000

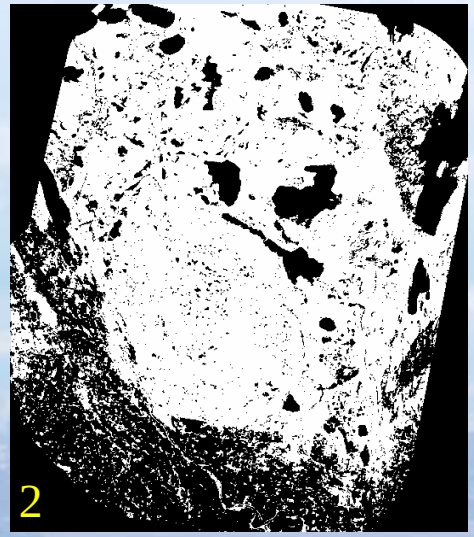
Fragmentation Assessment

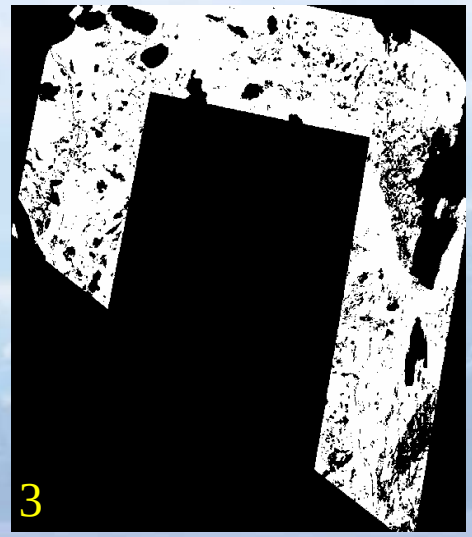
FRAGSTATS used to evaluate several simple fragmentation metrics:

- Percent area
- Patch density
- Edge density
- Mean perimeter to area ratio
- Percentage of like adjacencies

Statistics calculated for 3 landscape extents at 30 m and 90 m resolutions using forest/non-forest landscape model:

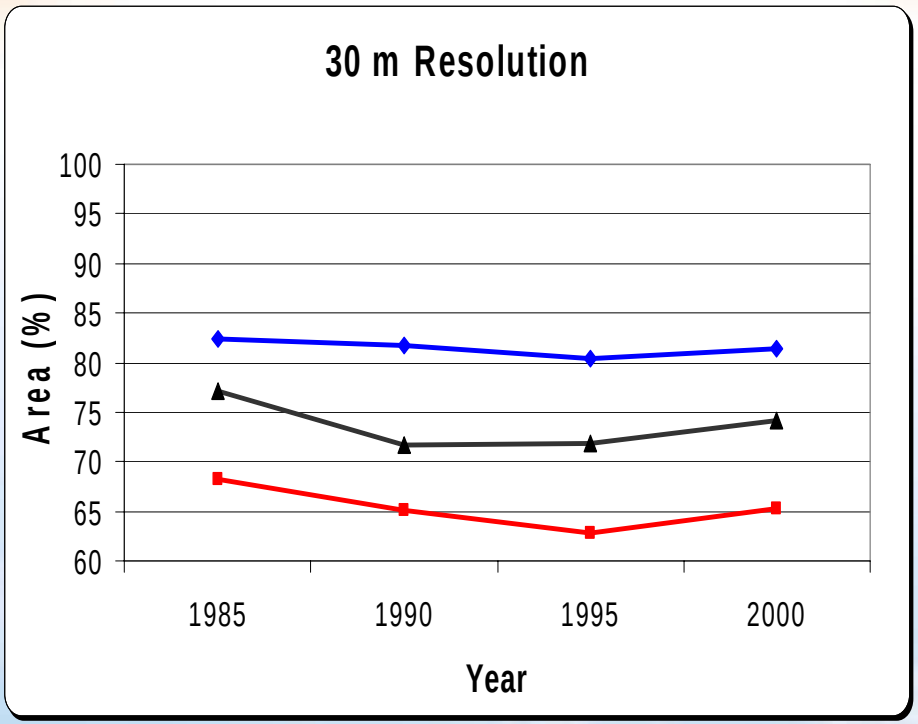
1. Park (least fragmented)
2. Park+greater park ecosystem (GPE)
3. GPE – Agriculture belt to the south (most fragmented)

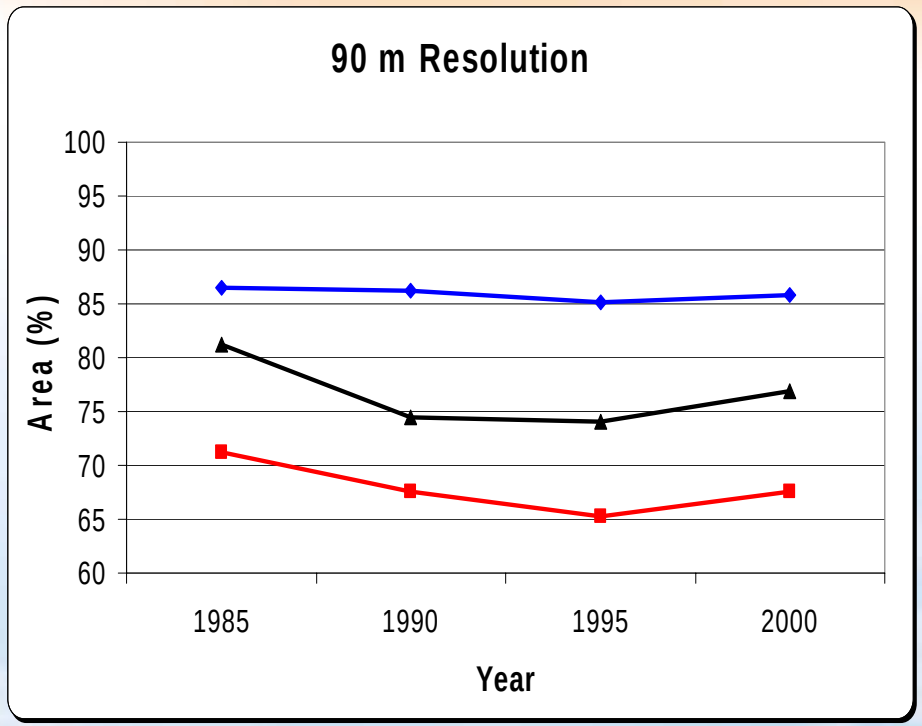




Fragmentation Results:

Percent Forest Area

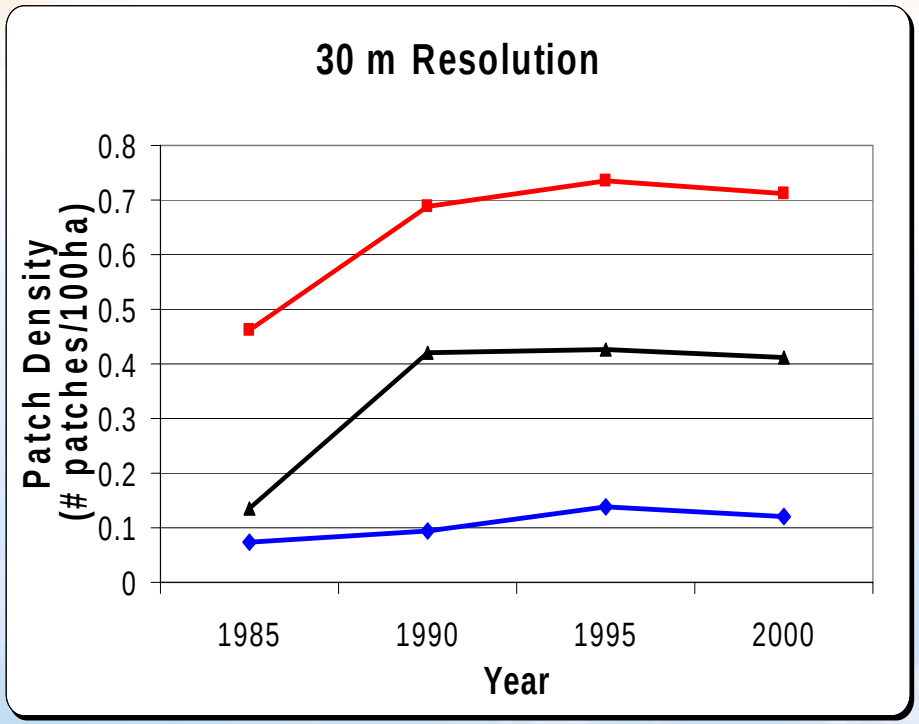


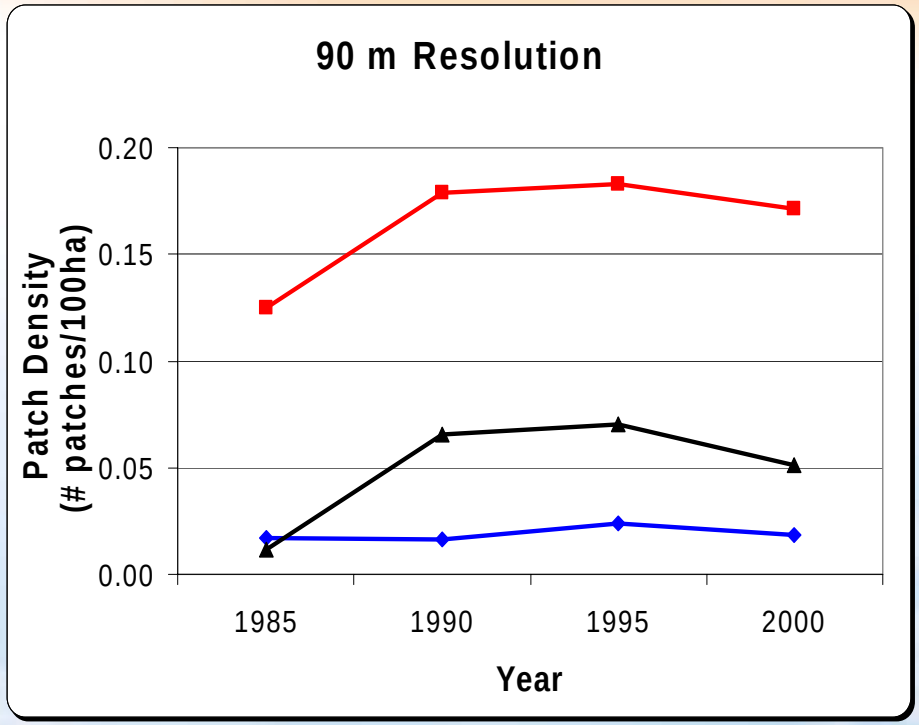


- Park (least fragmented)
- Park+GPE
- GPE-Agriculture (most fragmented)

Fragmentation Results:

Patch Density





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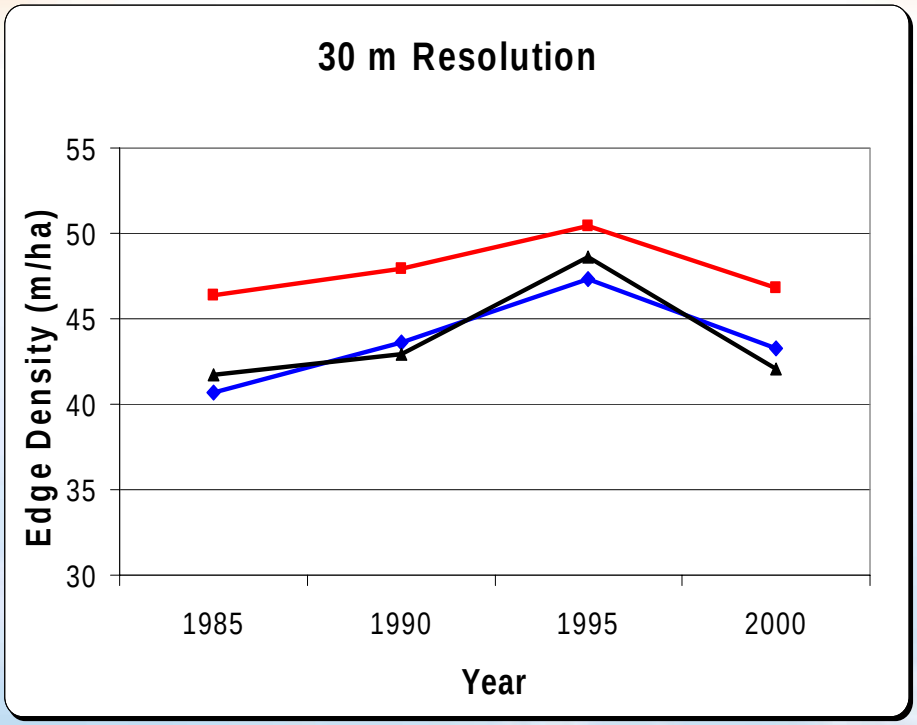
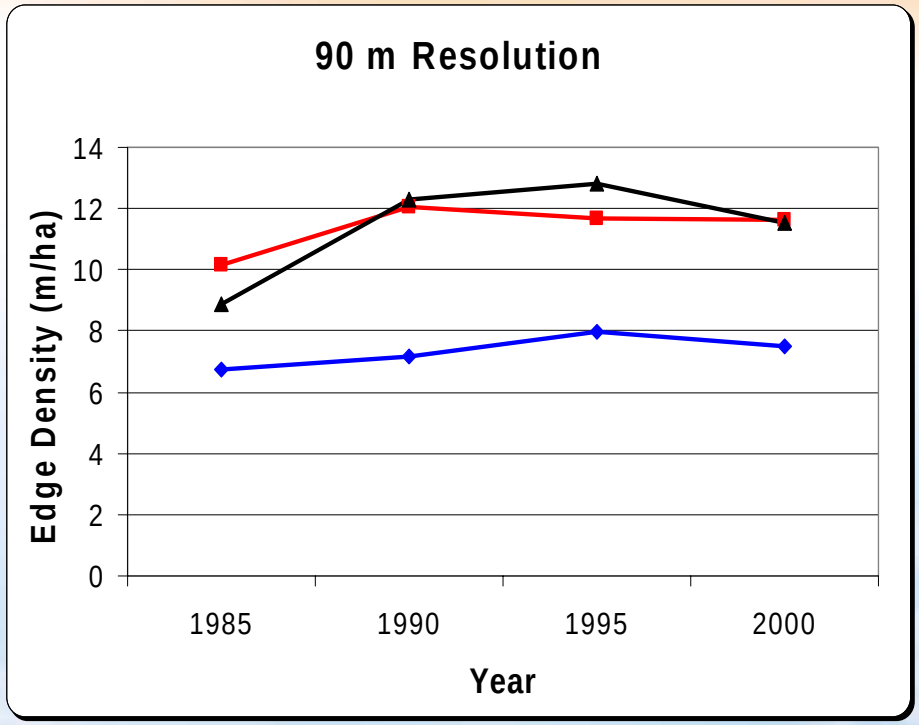
Fragmentation Results:

Edge Density





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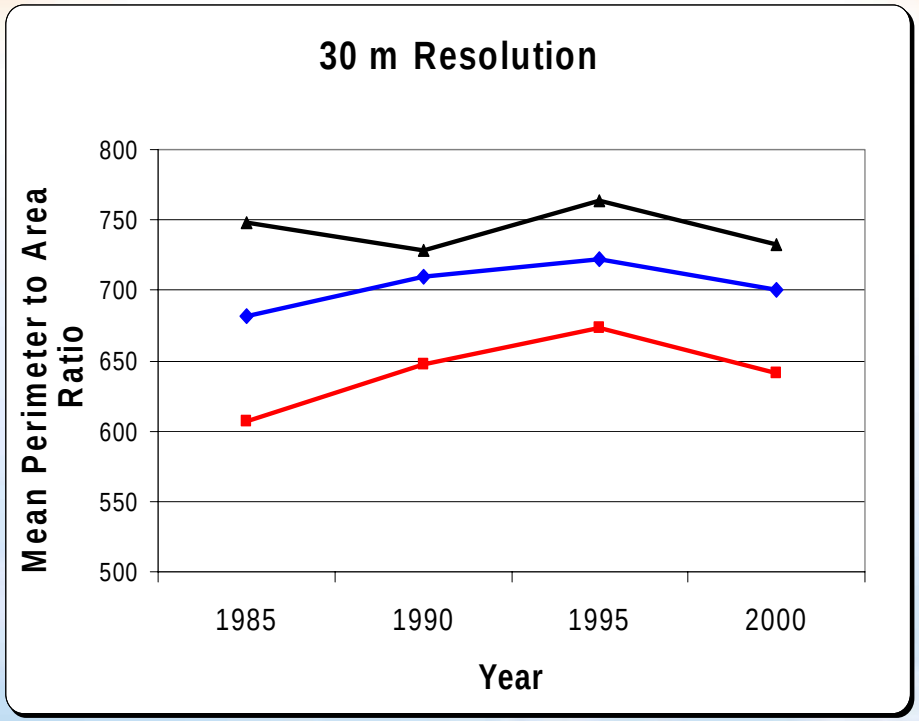
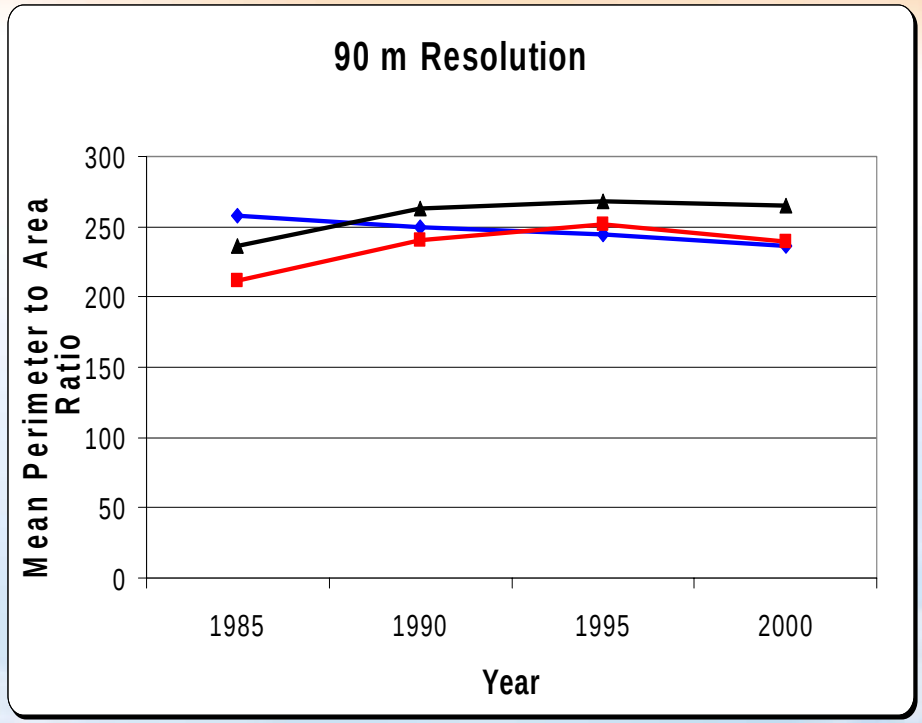
Fragmentation Results:

Mean Perimeter to Area Ratio





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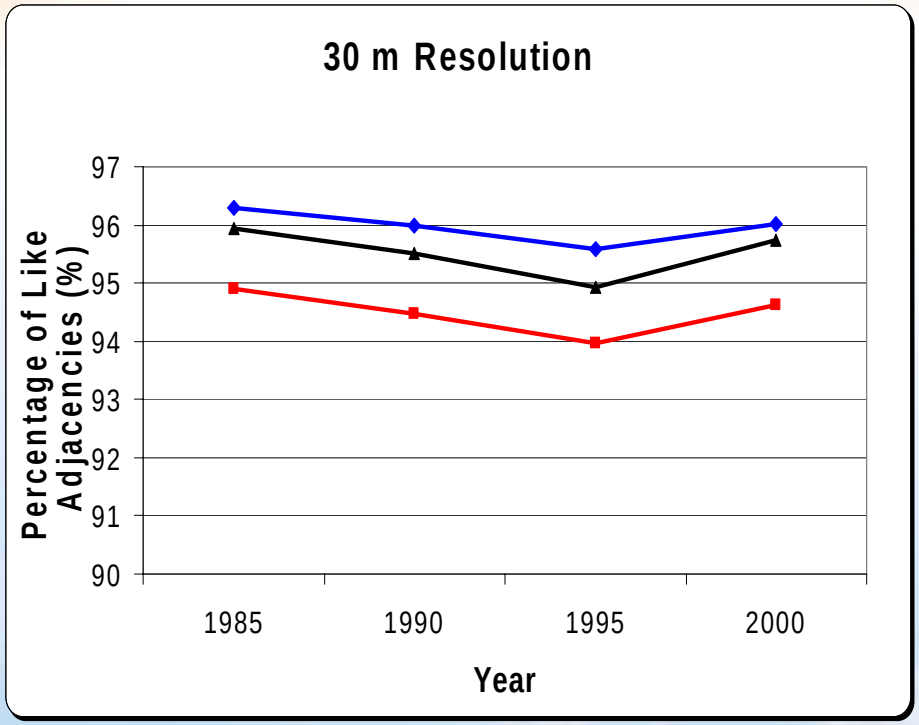
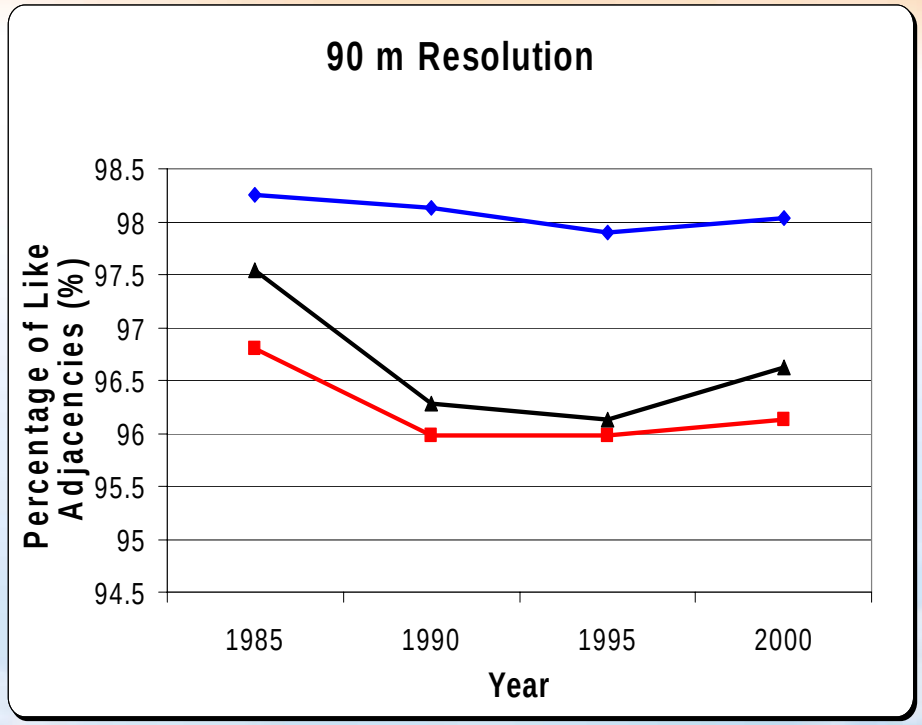
Fragmentation Results:

Percentage of Like Adjacencies





- Park (least fragmented)
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Conclusions

- **Meaningful fragmentation indices were observed at 90 m resolution.**
- **Fragmentation results were highly sensitive to noise.**
- **Need to develop and evaluate a change\classification updating methodology that maintains a high degree of consistency over time.**
- **Need to include roads in the analysis from existing GIS and manual updating.**
- **Need to evaluate results for other more complex landscape models.**
- **Validation data required for more meaningful evaluations.**